Cartesian Coordinates $\Leftrightarrow$ Cylindrical Coordinates

$(x,\ y,\ z) \Leftrightarrow (\rho,\ \phi,\ z)$

Point/variable conversions :

$$\rho = \sqrt{x^2 + y^2} \qquad x = \rho\cos\phi \qquad \cos\phi = \frac{x}{\sqrt{x^2 + y^2}}$$

$$\phi = \tan^{-1}\left(\frac{y}{x}\right) \qquad y = \rho\sin\phi \qquad \sin\phi = \frac{y}{\sqrt{x^2 + y^2}}$$

$$z = z \qquad z = z$$

Vector conversions :

$$\overline{A} = \hat{a}_\rho A_\rho + \hat{a}_\phi A_\phi + A_z\hat{a}_z = A_x\hat{a}_x + A_y\hat{a}_y + A_z\hat{a}_z$$

$$\hat{a}_x = \cos\phi\ \hat{a}_\rho - \sin\phi\ \hat{a}_\phi \qquad \hat{a}_\rho = \cos\phi\ \hat{a}_x + \sin\phi\ \hat{a}_y$$

$$\hat{a}_y = \sin\phi\ \hat{a}_\rho + \cos\phi\ \hat{a}_\phi \qquad \hat{a}_\phi = -\sin\phi\ \hat{a}_x + \cos\phi\ \hat{a}_y$$

$$\hat{a}_z = \hat{a}_z$$

$$A_\rho = A_x\cos\phi + A_y\sin\phi \qquad A_x = A_\rho\cos\phi - A_\phi\sin\phi$$

$$A_\phi = -A_x\sin\phi + A_y\cos\phi \qquad A_y = A_\rho\sin\phi + A_\phi\cos\phi$$

$$A_z = A_z \qquad A_z = A_z$$

Dot Products :

$$\hat{a}_x \bullet \hat{a}_\rho = \cos\phi \qquad \hat{a}_y \bullet \hat{a}_\rho = \sin\phi \qquad \hat{a}_z \bullet \hat{a}_\rho = 0$$

$$\hat{a}_x \bullet \hat{a}_\phi = -\sin\phi \qquad \hat{a}_y \bullet \hat{a}_\phi = \cos\phi \qquad \hat{a}_z \bullet \hat{a}_\phi = 0$$

$$\hat{a}_x \bullet \hat{a}_z = 0 \qquad \hat{a}_y \bullet \hat{a}_z = 0 \qquad \hat{a}_z \bullet \hat{a}_z = 1$$